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my conduct will be interpreted as my judgment of compensation. The significance of the terms used depends on the fact that there are five essential constants of matter found in every particle of the universe; these are unity, extension, speed, persistence, and consciousness. If the hypothesis that affinity is consciousness and choice fails, and affinity is still unexplained and consciousness is found only in animal bodies, then there are but four essentials in inanimate matter, while there are five in animate matter, and whenever a new animal body is evolved a fifth essential is evolved.

If the five essentials of properties are found in every body this should appear not only as affinity, but it should appear in a series in all bodies. This I have tried to show. I have called the essentials *concomitants*, and this term seems to offend Mr. Ward, but the term concomitant is used in the same sense in all modern and scientific psychology. Again, I have tried to show the nature of reciprocity; as, for example, when I set forth that quantities or properties that can be measured are the reciprocals of categories, or properties that can be classified. When I come to the second volume I shall greatly multiply these series and shall then systematize them into an argument; but I shall try not to make a pentalogic series where none exists, as Mr. Ward has done in the tables which he thinks he has compiled from my book. I find scientific men marshalled in three camps—one as champions of idealism, another as champions of dynamism, and a third rejecting all philosophy as vain. I have begun on the attempt to propound a Philosophy of Science.

J. W. POWELL.

ARTIFICIAL DREAMS.

TO THE EDITOR OF SCIENCE: Maury and some others have, to a certain extent, experimented on artificial dreams, but, at my instance, my students, Messrs. Matthews and Morley, undertook a series of experiments which may have some value in further illustrating the subject and pointing the way to further work. The method employed was for the one at an early hour in the morning to stimulate sensation in the other for a brief period, often 30 seconds, and then waken the dreamer, who at

once recorded the dream. In general, the dreamer did not know beforehand what stimulus was to be applied.

The olfactory element in dreams being little recorded by experimenters, particular attention was paid to this point. Smell was slightly stimulated with heliotrope, and visual images mostly resulted, but in ten cases the dream was also olfactory, twice the dream being of a bunch of *Violets* and of smelling them. In a very strong stimulation of heliotrope the dream was of being choked with smell of perfume. This dream was in its early part composed of remarkable and vivid visual images. The dreamer flew on an air-ship through a snow-storm, and then over a country covered with white enamel and filled with white elephants, one of which pulled down the air-ship but soon released it, and then the whole herd flew off 'like so many butterflies.' This imagery has the characteristic quality of opium dreams.

In taste stimulation by salt and water there was a dream of eating olives.

In stimulating hearing repeatedly with a middle C tuning fork, within an interval of two weeks, a visual-auditory dream was repeated in 'every detail.' A fork in a lower octave gave dream of hearing fog horn, but no visual image. Another time it was the roar of a lion, but no visual image.

The record gives for temperature stimulation 2 pure temperature dreams, and 3 visual and temperature; for pressure stimulation 2 visual and pressure, for smell stimulation 1 pure smell and 6 pure visual and 10 visual and olfactory; for hearing stimulation 7 pure auditory, 6 visual and auditory.

These reports suggest that artificial dreams may be divided into three classes: First, the simple dream, where the stimulus is removed at the least sign of reaction, and the consequent dream is usually vague and momentary. Second, the cumulative dream, where the stimulus is continued and made to increase to even the highest point of excitation, and the dream has a definite intensifying development till the waking point. (An interesting dream would probably be produced by a metronome brought nearer and nearer, either directly or through a tube connected with the dreamer's ear.) The

third class is the complex dream which may be determined by different kinds of stimuli successively applied. These reports also suggest a practical matter that those who find dream pleasures a necessity, as the opium eater, might obtain a large measure of such pleasures by perfume and other stimuli which do not leave unhealthy reactions.

As to my own dreams I may mention a few facts which may be suggestive. My dreaming is commonly of places and persons which are totally unknown, but, of course, the types are familiar. I often dream of being in a crowd and studying faces which I have never seen before. Similarly I dream of being in a bookstore and picking up new books which I have never seen, and reading many pages, and looking at strange pictures. I once awoke from a vivid dream of this sort, and was able to recall several sentences, and to notice that they were far from my own style of writing, and had an individuality of their own which I could not recognize. But all this merely means that those in whom the constructive imagination is strong exercise it freely in sleep.

A singular case of dream stimulation is this: I dreamed of being in a strange hilly country, and a man appeared driving a tandem. In vain he sought to get up the hills, and the horses became so ludicrously tangled that I burst into loud laughter; this was heard in another room. In my laughter I heard other voices laughing, all from a single direction, but there was no visual image. It is highly probable that my dream of hearing others' laughter was stimulated by hearing my own laughter.

Maury makes the 'embryogeny of the dream' to consist in 'hypnagogic hallucination,' that is, in the stage of waking just previous to sleep visual and auditory hallucinations occur which are carried into sleep, but it appears to me that he lays much too great stress on the point. I noticed the other morning during a succession of cat-naps that the formation was not in any wise hallucinatory. Awake for a few seconds I thought of dressing, and had the images of the process but not hallucinatory, but knowing them to be ideas to be realized, but the senses quickly falling asleep, these images constituted a dream reality, I was really dressing. Very

commonly our last waking thoughts turn into dream without any hallucinatory stage.

HIRAM M. STANLEY.

LAKE FOREST, ILL., January 23, 1899.

TROWBRIDGE'S THEORY OF THE EARTH'S MAGNETISM.

IN an article entitled 'The Upper Regions of the Air,' in the January number of the *Forum*, Professor John Trowbridge proposes a new theory to account for the phenomena of the earth's magnetism, of the northern lights and of thunder storms.

His theory, briefly stated, is that those waves of energy coming from the sun whose wavelengths are of the order of those concerned in the X-ray phenomena are completely absorbed by the atmosphere and transformed into electric and magnetic energy in the upper regions of the air, and that being thus transformed they fail to manifest themselves as light at lower altitudes. According to Perrin and Winkermann, the X-rays have the property of communicating an electric charge to conductors. "If, therefore, X-rays reach the earth from the sun they are competent to give an electrical charge to our atmosphere. The side, therefore, of the earth turned toward the sun would receive a charge in the upper good-conducting regions of the air. This charge would tend to dissipation, and there would be a flow of electricity toward the side of the earth not turned to the sun. The rotation of the earth on its axis from west to east would bring forward at each revolution fresh regions of the upper air to receive the electrical charging from the sun. There would be an accumulation of electricity on one side of the earth and a diminution of electricity on the other. The conditions of the equalization of the electrical charge, or the flow of electricity, might be determined by the direction of rotation of the earth. If this flow took place from east to west, just opposite to the direction of rotation of the earth, and were sufficiently powerful, it would produce the magnetic north and south poles. It has been found that air submitted to the action of the X-rays continues for some time to manifest their influence. We should, therefore, expect a fall of electric pressure between the regions just entering into daylight